teeth like *Volutidæ*, which are broad, lunate, with nine small, conical, rather distant, transparent denticles on its front edge. *Voluta* (*Vespertilio*) has a single series of three-toothed teeth on the tongue like *Yetus* and *Cymbium*, but the central toothlet is much longer than the lateral ones.

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## BIBLIOGRAPHICAL NOTICES.

*Système Silurien du Centre de la Bohême.* 1ère partie, *Recherches Paléontologiques. Trilobites*, par J. Barrande. 2 vols. 4to.

The history of the palæozoic formations, both as regards the development of the organic life of the period and the physical conditions under which they were accumulated, appears almost to be more clearly revealed to us than that of the more recent accumulations of the later tertiary period. That a knowledge of the primæval fauna of our planet should be invested with peculiar interest to the zoogeologist can scarcely be doubted, either in its relation to existing nature, or as pointing out to us the peculiar types of the earliest forms of animal existence. But few years have elapsed since a vast portion of the earlier fossiliferous rocks were classed under the names of greywacke and clay-slate, and were considered entirely destitute of organic forms. Traces of them were, however, discovered in the Scottish series by the acute geologist Hutton, and other observers, as Lhwyd, &c., had also noticed them in some localities. From the comparative rarity of the fossil organisms in the palæozoic formations known at that period, they could not have been used as a means of distinguishing the different members of the series, nor indeed was the attempt made so to classify them; for the great principle of characteristic fossils, subsequently enunciated by W. Smith, was applied chiefly to the secondary group of rocks. Little, however, was effected in the classification of these older greywacke rocks until the border counties of England and Wales and a portion of the Principality itself was made the special object of some years' study by Sir R. Murchison, who, "par ses conquêtes sur la nuit du temps," first initiated us with a knowledge of the earlier palæozoic epoch, comprising the Silurian system. From that period the active researches of geologists have demonstrated the existence of this group throughout large portions of the globe, characterized on the whole by similar forms of organic life, although, as would naturally be expected, modified in the subdivisions by local peculiarities. Since the publication of the 'Silurian System,' large and expensive works on the subject have been issued from the presses of America and Europe, and Siluria seems to be singularly fortunate in the zeal and liberality of her illustrators. Among the more remarkable and interesting is the magnificent volume by M. Barrande. A native of France, and formerly tutor to the Comte de Chambord, to whom the work is dedicated, M. Barrande has, from circumstances, resided for twenty years on the Silurian soil of Bohemia. Commencing his researches

in 1830 on the so-called "transition series," he was further stimulated in 1840 by the perusal of the 'Silurian System,' and his labours assumed a definite plan.

Those only who are conversant with the country, or will peruse the volume, can form any idea of the zeal and energy requisite for overcoming the difficulties of exploring this district, and the labour and great pecuniary outlay necessary for accumulating the treasures of this portion of the ancient Silurian fauna. Independently of his own explorations over the whole district with a view of finding the fossiliferous localities, whether in worked quarries, in ravines, or on the weathered surfaces of rocks, M. Barrande trained under his own eye and practically instructed a number of intelligent workmen (furnishing them with the necessary implements) for the more effectual carrying out his researches at different points, and who became so habituated to, and interested in, the employment, that scarcely the fragment of an organism was ever lost.

The following table will show the numerical result of species obtained during these researches :—

| | | Genera. | Species. |
|---|---|---|---|
| VERTEBRATA | Fishes | 1 | 1 |
| ARTICULATA | Trilobites | 35 | 252 |
| | Cytherinidæ | 1 | 25 to 30 |
| | Various | 4 | 4 |
| MOLLUSCA | Cephalopods | 10 | 270 to 280 |
| | Pteropods | 2 | 25 to 30 |
| | Gasteropods | ? | 140 to 150 |
| | Brachiopods | ? | 180 to 200 |
| | Acephala | ? | 140 to 150 |
| | Bryozoa | 3 | 22 to 25 |
| RADIATA | Echinoderms | ? | 25 to 30 |
| | Zoophytes | ? | 50 to 60 |

From the the above it appears there are 1200 species of fossils from the Bohemian basin, averaging about eighty miles in length and thirty in width, a sufficient dish for any Silurian gourmand. The mere accumulation of such fossil treasures might be sufficient; but when the labour necessary for the determination of so many species is further considered, we must admire the industry of the author, and we are well aware of the conscientious care with which the whole has been effected. For (unlike some zoo-geologists, who centred in or satisfied with the narrow limits of their own knowledge and locality, not looking for determinations or comparisons elsewhere) M. Barrande has, with the true spirit of a scientific man, entered into correspondence with those naturalists who could assist him, and even visited many localities, this country in particular, with a view of personally comparing the Bohemian fossils with the published types, as well as with those not yet figured*. The present volume, with the

* Particularly the collection of the Geological Survey, with the kind co-operation of Prof. E. Forbes, and the important assistance of Mr. J. W. Salter's practical knowledge, who has made the palæozoic fauna his especial study.

atlas, (containing the Trilobites,) is only the first portion of the work, which will be followed by two more (containing the Cephalopods, &c.), forming a complete history of the Silurian system of Bohemia. The text, consisting of more than 900 pages, is devoted (with the exception of the historical introduction and geological sketch) to details connected with the determination of the family of Trilobites, and is illustrated by nearly 2000 carefully engraved figures of all the forms and varieties assumed by the different species.

The *Historical introduction* gives a chronological list of all the authors who have contributed to the knowledge of the palæozoic formation of the centre of Bohemia, with an analysis of their respective merits and the points of special interest furnished by each writer.

The *Geological sketch*, which is merely preliminary to a more detailed one to be given in the third volume, is inserted for the purpose of enabling the reader to understand the position of the stratum indicated for each species.

The Silurian rocks of Bohemia are divided by M. Barrande into an upper and lower system, of four stages each, reposing on one another, and having a conformable stratification, the lower group, A–D, being chiefly siliceous and argillaceous, the upper, E–H, mostly calcareous, and reposing on a trappean base and schists with Graptolites.

*Upper Division.*

H. Argillaceous schists, containing but few fossils.

G. Argillaceous limestone, with 10 genera and 40 species of Trilobites, 10 Brachiopoda, 6 genera and 10 species of Cephalopods.

F. Mostly calcareous; 10 genera and 75 species of Trilobites, 8 genera and 109 species of Brachiopoda, 6 genera and 26 species of Cephalopods.

E. Trappean and schistose rocks; 17 genera and 78 species of Trilobites; 22 genera and 220 species of Cephalopods; 65 species of Brachiopods.

*Lower Division.*

D. Quartzites and schistose rocks; 23 genera and 61 species of Trilobites; also Cephalopods, Brachiopods, &c.

C. Protozoic schists, argillaceous schists, with 7 genera and 25 species of Trilobites; other forms very rare.

A, B. Azoic series, chiefly crystalline and argillaceous schists and conglomerates.

The divisions C to H are distinguished from one another, (1) by a marked predominance of families or different classes in each of the superposed stages; (2) in having a very small number of species common to two or more stages.

The palæontological contrast consists principally in the occurrence of certain genera exclusively characteristic of the lower division C, D, as *Paradoxides*, *Conocephalus*, *Ellipsocephalus*, *Sao*, *Agnostus*, *Asaphus*, &c.; also in the development of certain other types, as *Illænus* and *Ampyx*, which scarcely pass the limits of this division.

The upper division, E–H, presents other genera which in Bohemia

do not occur in the lower, as *Harpes, Bronteus, Proëtus, Deiphon, Phragmoceras, Ascoceras, Trochoceras,* and *Cardiola,* &c. We may remark, however, that in the genera common to the two divisions, the species present considerable modification of form. Thus, in *Acidaspis,* the species belonging to the lower division have ten or more thoracic segments, while those of the upper possess only nine. Other specific modifications are presented in the genera *Cheirurus* and *Ampyx,* which are also found in both divisions.

Decided as is the line of demarcation between the two great divisions, by the outburst and spreading over of a vast mass of trappean matter at the termination of the lower division, yet a curious fact is recorded by M. Barrande, in the local appearance or colony of fifty-seven species belonging to the third fauna E, within the limits of the second or lower fauna D. This colony of species, limited in extent, appears therefore to have survived, either by migration or otherwise, the causes which effected the extinction of the whole lower fauna with which it is intercalated.

Of the three successive Silurian faunas, defined by the distribution of the genera of Trilobites, the lower or primordial one C, contains only one genus, *Agnostus,* which passes into the second, and that under different specific forms. This group corresponds to the Olenus schists of the Malverns, and the Lingula beds of Merionethshire, &c. In England, according to Mr. Salter, "*Agnostus* is generally characteristic, not of the first, but of the second zone or true Llandeilo flags." In the second fauna D, the *genera* of Trilobites have attained their maximum development; some are peculiar to it, others have reached their numerical specific maximum, and a third set have their greatest development in the superior fauna. Associated with these are numerous Cephalopods, Brachiopods, Pteropods and Acephala, which have a very unequal geographical distribution. This group appears to be the equivalent of the Llandeilo and Bala beds of N. Wales.

These two faunas may be regarded as only subsections of the lower division, and this appears to be the opinion of Mr. Salter, who, from an examination of the British localities, states, "It may perhaps be necessary hereafter to modify the conclusions drawn by so able and successful an observer as M. Barrande, as to the primordial and isolated character of his earliest fossil group; it may be a local, and not a general phænomenon." The third fauna E–H, forming the upper division and equivalent to the Upper Silurian, contains many genera of the second fauna, but the assemblage of the specific forms and their characters are very different. Here, however, the *species* of Trilobites, and not the genera, attain their maximum.

The upper limits of this fauna, or its relation to the Devonian, are perhaps not distinctly defined, although M. Barrande states that Silurian Trilobitic types range throughout, accompanied by Brachiopoda, Gasteropoda, &c. In a previous memoir on the Brachiopoda, by M. Barrande, we thought we had recognized many forms very analogous to, if not identical with, Devonian species of other districts; this, however, is a subject for further inquiry.

Although a unity may pervade the Silurian system as a whole, yet that the members comprising it may present a diversity is fully shown by comparing the local faunas, in their relation to the epoch at which each class has attained its development, in different countries. Thus, "The Cephalopods have flourished in the Silurian seas of N. America, Russia and Sweden, during the deposition of the lower division, scarcely a trace of them being found in the equivalent strata of England and Bohemia; these mollusks, however, abound in the upper division of these latter countries, becoming rare at the same epoch in Russia and N. America. England and Bohemia present another contrast in the Brachiopoda. In the former country this class attained its maximum towards the *base* of the upper division or Wenlock stage, while the Cephalopods abounded in the superior Ludlow beds. The reverse has happened in Bohemia, where the maximum of the Cephalopods is found in group E, and that of the Brachiopods at a higher level in group F." In comparing, however, the geognostical and palæontological characters, there is a general resemblance between the two great divisions of the Silurian strata of Bohemia and those of the typical district of England, France, Sweden, Russia, and N. America.

The *Palæontological portion,* which forms the chief part of the volume, is full of most curious and instructive data, and is divided into two parts, the first comprising the special study of the different parts and elements of Trilobites, with an essay on their classification; the second contains a detailed description of the genera and species found in Bohemia.

The first portion is treated in a series of sections, of which the following are the most important:—The form and principal parts of the body of Trilobites (illustrated in plate 1);—the elements composing the head (pls. 2 & 3), as the glabella, the sutures, the eyes (pl. 3), their form and proportion, the cheeks or lateral lobes, the hypostome and epistome;—the elements of the thorax, as the form of the thoracic segments and their articulation, the two types of the pleura (illustrated in pls. 4–6), the number of segments, the power of coiling up, and the value of the characters furnished by it;—the elements of the pygidium, its form, axis, lateral lobes, and contour;—nature and ornaments of the shell of Trilobites;—metamorphosis and mode of existence of Trilobites;—the distribution of them, both as regards their vertical and horizontal diffusion, and which is graphically illustrated in pls. 50 & 51.

Among the protean forms of Trilobites, the *Sao hirsuta* appears the most remarkable. First described in 1846, its numerous synonyms would lead us to infer that it had passed through all the vacillations of an older palæontological nomenclature, for it rejoices in more names than would gladden the heart of a Spanish Hidalgo. It has been assigned to no less than twelve genera and twenty-two species; but the minute researches of M. Barrande have clearly proved that between the embryonic state, which is simply a flattened disk with a body axis, and the head and thorax not distinct, to the adult form with nineteen articulations, this Trilobite has passed through eighteen

different degrees of development, to each of which a distinct name has been given.

Without proceeding with further details on the many interesting points treated of, we may cordially recommend this work to the student of palæozoic geology, not only as illustrating a chapter of its history, but from the fact that the Trilobites play an important part in the Silurian fauna. The naturalist also, interested in the study of the Articulata, will here observe the frequent anomalies that are found in the arrangement of the elements of the bodies of these ancient crustaceans, compared to the regularity of the law recognized among the modern forms,—presenting an important suggestive subject, and which must not be forgotten in the great question regarding the successive development of this group of animals. We may therefore hope that the zoological interest, which has long existed respecting the Trilobites, will be still further excited by the great variety of new facts observed in the Bohemian species.

*Popular Physical Geology.* By J. B. Jukes, F.R.S. 12mo. Reeve and Co., London, 1853.

This volume forms part of a series of useful works on Natural Science, and is intended to convey, in a popular manner, the general principles of physical geology. The author, who is well acquainted with practical field geology, does not pretend to have given much original matter, in the sense of new facts, the object being to describe the common facts and principles of geology, in a clear and concise manner, without entering too much into the detail of the observations by which those facts have been discovered, or on which those principles have been established. In this respect he has somewhat succeeded, treating the subject with a freshness and spirit, and showing that "geology is not a mere dull and barren disquisition on the nature and composition of rocks and stones, but has become incidentally, as it were, the opening to a full, rich, and varied history of the earth, embodying the labours of the naturalist, the chemist, and the physicist,—of all who study the living beings that people it, the constitution of the matter that composes it, or the laws of force that act upon it—into one great harmonious whole." The first part of the work contains the elementary facts and principles, and is followed by a general sketch of the series of stratified rocks. The subject of the formation of sand, gravel, clay, &c., is clearly and concisely treated, and it is well observed, that he who thoroughly understands the origin and nature of common sand, has made no despicable commencement in the study of the science. We could have forgiven the author, had he ventured a little more into the domain of palæontology, when treating of the stratified rocks, for it has become so essential a part of geology, that some acquaintance with it is necessary, just as a knowledge of chemistry and mineralogy are equally useful to the student of the crystalline and volcanic rocks. The accompanying plates are artistic, and illustrative of some principal features in physical geology.